Photoacoustic Measurements of Aerosol light absorption and scattering at four sites in and near Mexico City

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The MILAGRO field campaign was carried out in

March 1-30, 2006

in Mexico City.

MEGACITY AEROSOL EXPERIMENT IN MEXICO CITY (MAX-MEX)
Understand the local and global radiative and cloud microphysical impacts of aerosol from a large city, Mexico City.

Sometimes transportation may pollute in a different way! Methane Makers…

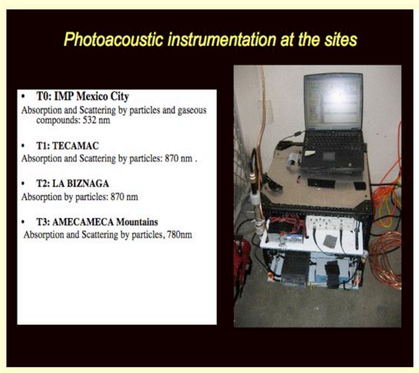
ABSTRACT

As part of the Megacity Impacts on Regional and Global Environments, MIRAGE-Mex deployment to Mexico City in the period of 30 days, March 2006, a suite of photoacoustic spectrometers (PAS) were installed to measure at ground level the light absorption and scattering by aerosols at four sites: an urban site at Instituto Mexicano del Petroleo (Mexican Oil Institute, denoted by IMP), a suburban site at the Technological University of Tecamac, a rural site at "La Biznaga" ranch, and a site at the Paseo de Cortes (altitude 3,810 meters ASL) in the rural area above Amecameca in the State of Mexico, on the saddle between the volcanoes Popocatepetl and Iztaccihuatl. The IMP site gave in-situ characterization of the Mexico City plume under favorable wind conditions while the other sites provided characterization of the plume, mixed in with any local sources. The second and third sites are north of Mexico City, and the fourth site is south. The PAS used at IMP operates at 532 nm, and conveniently allowed for characterization of gaseous absorption at this wavelength as well. Instruments at the second and third sites operate at 870 nm, and the one at the fourth site at 780 nm. Light scattering measurements are accomplished within the PAS by the reciprocal nephelometery method. In the urban site the aerosol absorption coefficient typically varies between 40 and 250 Mm-1 during the course of the day and significant diurnal variation of the aerosol single scattering albedo was observed. Comparisons with TSI nephelometer scattering and aetholemeter absorption measurements at the T0 site will be presented. We will present a broad overview of the diurnal variation of the scattering and absorption as well as the single scattering albedo and fraction of absorption due to gases at the IMP site. Insight on the dynamical connections will be discussed.

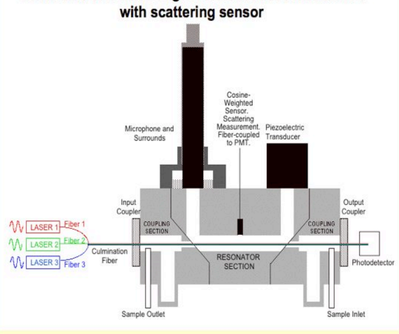
MEASUREMENT SITES

- T0: Instituto Mexicano del Petroleo, Distrito Federal, Northeast Mexico City.
- T1: University of Tecamac, Tecamac, north of Mexico City.
- T2: Rancho La Biznaga, Road to Pachuca Hidalgo, north of Mexico City.
- T3: Paseo De Cortes, Amecameca
  (All sites inside Mexico City)

Photoacoustic instrumentation at the sites

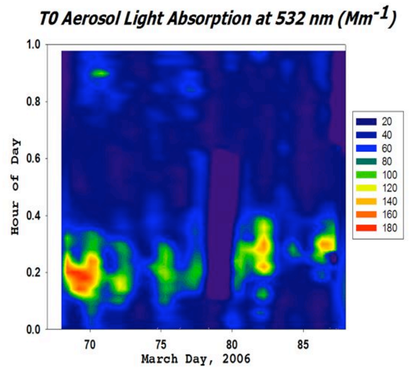


Schematic of 3 wavelength Photoacoustic instrument with scattering sensor



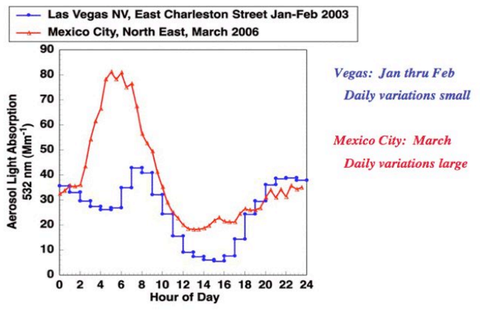
TO Site Mexico City Aerosol Optics for 532 nm (G. Paredes & P.Arnott) and 550 nm (J. Gaffney &N. Marley)

T0 Aerosol Light Absorption at 532 nm (Mm^{-1})



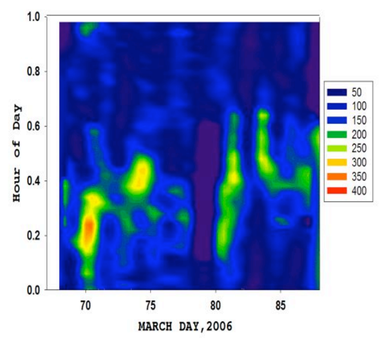
Aerosol Absorption, Day 60 is March 1st. Note the day to day variability in the peak absorption, probably due to meteorology.

A tale of 2 Cities…

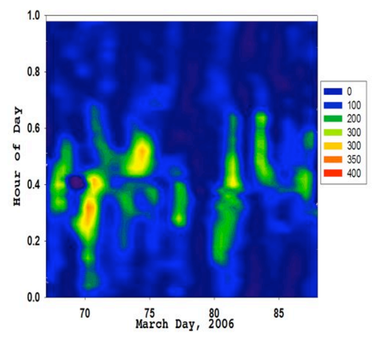


Mexico City or Las Vegas NV? A Tale of Two Cities…

T0 Aerosol Light Scattering at 532 nm (Mm^{-1})

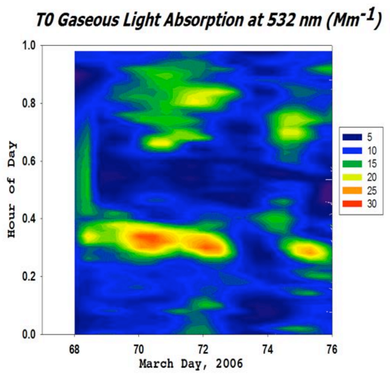


T0 Aerosol Light Scattering at 550 nm (Mm^{-1})

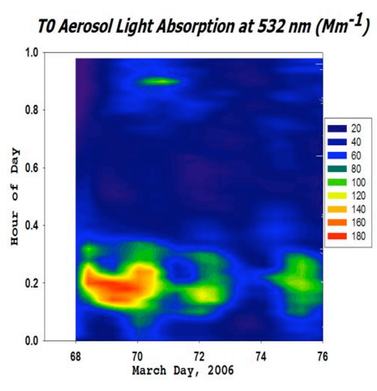


Aerosol Scattering
Aerosol Scattering peaks later in the day than absorption, probably due to dust, OC, and inorganics.

T0 Gaseous Light Absorption at 532 nm (Mm^{-1})

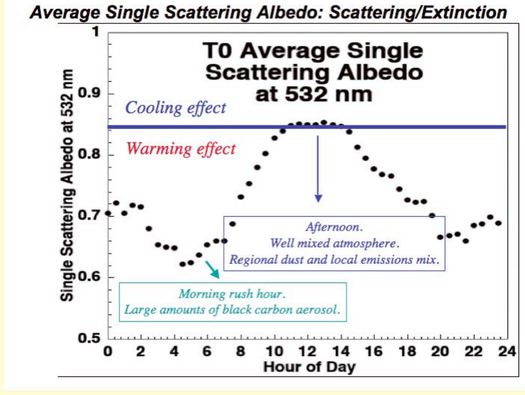


T0 Aerosol Light Absorption at 532 nm (Mm^{-1})



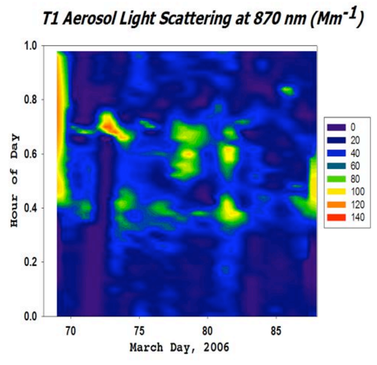
<u>Gaseous Absorption, 532 nm, mostly NO2,</u>
(1/3 Mm-1 / ppb efficiency for absorption by NO2)
Note that gaseous absorption peaks 2 hours later in the day than particulate absorption. Peak particle absorption is 6x gaseous absorption peak.

Average Single Scattering Albedo: Scattering/Extinction

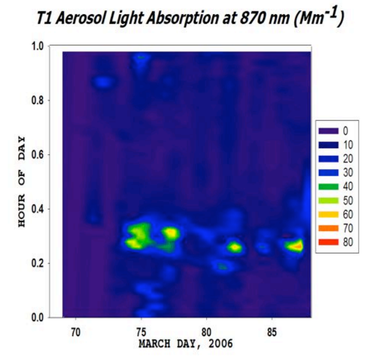


Aerosol Optics for 870 nm @ T1 30 minute average data. Day 60 is March 1st.

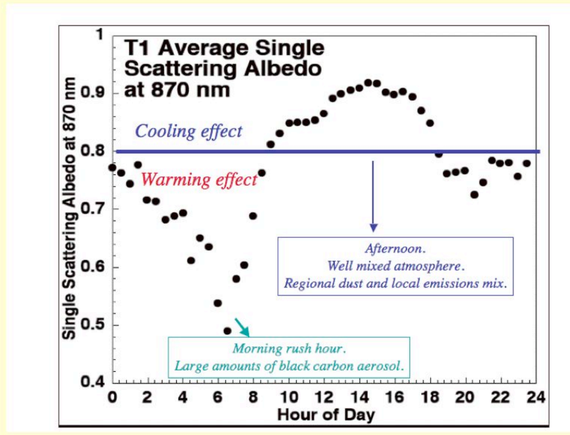
T1 Aerosol Light Scattering at 870 nm (Mm^{-1})



T1 Aerosol Light Absorption at 870 nm (Mm^{-1})

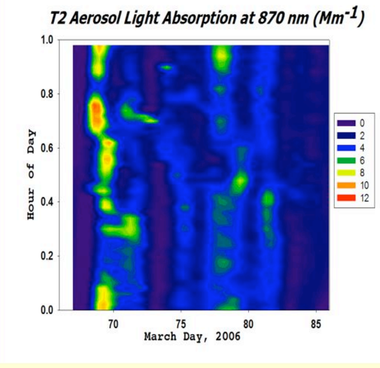


T1 Tecamac University typically has large amounts of windblown dust in the afternoon.



Aerosol Optics for 870 nm @ T2 30 minute average data

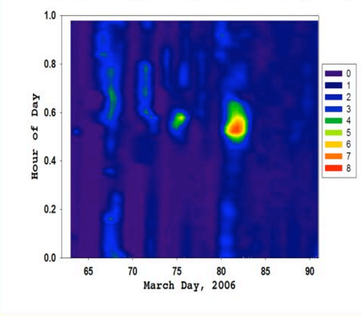
T2 Aerosol Light Absorption at 870 nm (Mm^{-1})



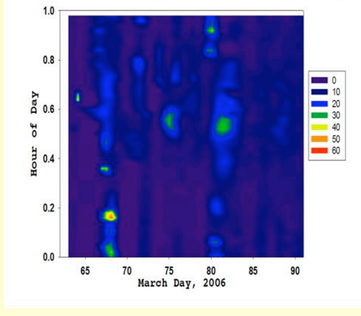
Rural Site: Absorption only, Long range plume transport from the south when level are higher.

Aerosol Optics for 780 nm @ T3 30 minute average data

T3 Aerosol Light Absorption at 780 nm (Mm^{-1})



T3 Aerosol Light Scattering at 780 nm (Mm^{-1})



SUMMARY

Significant day to day variations of BC are observed due to meteorology in the Mexico City Basin.

Peak gaseous absorption is approx. 2 hrs later in the day than peak peak particle absorption. Peak 30-minute-average aerosol absorption in Mexico City was 180 Mm^{-1}.

Daily single scattering albedos vary between 0.4 and 0.85 at 532 nm at the T0 site.
Transportation dominates aerosol optics in the morning and windborne dust is important in the afternoon, especially at the T1 site.

Acknowledgements
DOE ASP and NSF support, and the assistance of Manvendra Dubey and Claudio Mazzoleni of LANL with the instrument at the T0 site.

<u>Thank You for Stopping by!</u>